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### Independent Directors and Shared Board Control in Venture Finance

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Brian Broughman\*

# Independent Directors and Shared Board Control in Venture Finance

**Abstract:** In most startup firms neither the entrepreneurs nor the investors control the board. Instead control is typically shared with a mutually appointed independent director holding the tie-breaking seat. Contract theory, which treats control as an indivisible right held by one party, does not have a good explanation for this practice. Using a bargaining game similar to final offer arbitration, I show that an independent director as tiebreaker can reduce holdup by moderating each party's ex post threat position, potentially expanding the range of firms which receive external financing. This project contributes to the literature on incomplete contracting and holdup and improves our understanding of governance arrangements in startup firms.

**Keywords:** venture capital, control rights, incomplete contracting, board of directors

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## 1 Introduction

Financial contracting theory emphasizes that residual control can affect ex post outcomes and ex ante investment (Aghion and Bolton, 1992). The literature treats control as an indivisible right allocated either to a firm's entrepreneurs or to its investors (Kirilenko, 2001). The allocation of control may be contingent on future events, but when a firm needs to make a strategic decision the theory generally assumes the right is held by one party.

Venture capital is considered an ideal setting to study financing contracts (Kaplan and Strömberg, 2003; Hart, 2001).<sup>1</sup> Yet surprisingly, in most VC-backed

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<sup>1</sup> Several papers specifically model the allocation of control in VC-backed firms (Berglof, 1994; Hellmann, 1998, 2006; Kirilenko, 2001), and VC contracts are one of the few empirical settings used to test financial contracting theory (Kaplan and Strömberg, 2003; Cumming, 2008; Bengtsson and Sensoy, 2009, 2010).

firms neither the entrepreneurs nor the VC investors control the board. Kaplan and Strömberg (2003) find that a firm's VC investors control the board 25% of the time, and the entrepreneurs control the board only 14% of the time. In the remaining firms, 61% of the sample, board control is shared with a mutually appointed independent director holding the tie-breaking vote.

These data highlight a significant gap in the existing theory. The board has primary authority over corporate strategy and is recognized as a standard measure of residual control (Lerner, 1995; Kaplan and Strömberg, 2003). Yet, the existing theory – treating control as an indivisible right – applies to a setting that only occurs 39% of the time, and it cannot explain the most commonly observed startup board configuration.

To fill this gap in the literature I model the incentives created by shared control. I consider a board with three directors: one entrepreneur, one investor, and one independent director (a configuration I label “ID-arbitration”).<sup>2</sup> I compare entrepreneur control, investor control, and ID-arbitration. My analysis applies to a variety of important decisions frequently faced by startup firms – when to sell the firm, whether to hire a new CEO, how much to invest in a new technology, etc. – each of which requires board authorization.<sup>3</sup> The allocation of board seats is endogenous to the financing contract (Hermalin and Weisbach, 1998, 2003). The basic setup, assumptions, and conflict between private benefits and monetary returns follow Aghion and Bolton (1992).

The primary innovation of this article is to develop a new theory explaining the frequent use of ID-arbitration in startup firms. Under ID-arbitration the choice of action is the result of deliberation and voting among three directors. I model a bargaining process similar to final offer arbitration (Stevens, 1966). The entrepreneur and investor each propose an action. If they propose the same action the firm will pursue this strategy; however, if they propose different actions, the independent director must choose between the two proposals.

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<sup>2</sup> Not all firms that share control with an independent director are under ID-arbitration. The board may have more than three directors or multiple representatives from each group. I focus on ID-arbitration, however, because it is the simplest form of shared control. ID-arbitration applies to firms with multiple entrepreneurs or VC investors sitting on the board, provided the entrepreneurs as a group have similar interests and the investors as a group have similar interests. While this is generally a reasonable assumption there are cases where the interests of early investors may diverge from later round investors (Bartlett, 2006).

<sup>3</sup> Board authorization applies to a much broader range of corporate actions than shareholder voting (Clark, 1986), and the allocation of board seats can be decoupled from the distribution of shareholder votes (Kaplan and Strömberg, 2003). Consequently, even if a firm's VCs control the vote of shareholders they do not necessarily control the board of directors.

ID-arbitration can lead to the efficient outcome in some circumstances where entrepreneur control is unavailable and investor control would be inefficient. Because of the risk of holdup, entrepreneur control may fail to satisfy the investor's *ex ante* participation constraint. Moving to investor control increases the monetary returns that the firm can pledge to the investor, but may compromise the project's overall value. The controlling investor will ignore the entrepreneur's private interests, and the parties may be unable to renegotiate to the efficient outcome because the entrepreneur is wealth constrained (Aghion and Bolton, 1992).

By contrast, under ID-arbitration neither the entrepreneur nor the investor can unilaterally threaten to pursue their preferred action. Instead, they must propose actions that would be endorsed by the independent director. Similar to analysis of final offer arbitration (Crawford, 1979), the entrepreneur and investor have an incentive to converge toward the action most preferred by the independent director. This result is analogous to the convergence of political platforms predicted by the median voter theorem (Downs, 1957). The entrepreneur and investor effectively *create* a median voter by adding an independent director to the board.

The parties have an incentive to find an unbiased independent director. If the independent director always sides with the same party or otherwise colludes with one of the primary parties, this arrangement is no different than giving the entrepreneur or VC full control. Recognizing this concern I do not assume the independent director is unbiased. He is not a social planner. Yet, even a partially biased tie-breaking director can increase monetary returns relative to entrepreneur control and can reduce the costs of investor holdup that could arise under VC control. To the extent that there are opportunity costs associated with the entrepreneur's participation, ID-arbitration may expand the range of firms which receive external financing.

My analysis suggests a hierarchy of control rights. Firms will use entrepreneur control whenever possible. Entrepreneur control, however, may not provide sufficient revenues to give the investor his required rate of return. When this is the case, firms will first try to use ID-arbitration. However, in some instances investor control may be necessary, as it may be the only way to pledge sufficient monetary returns to ensure the investor's participation.

These predictions are consistent with empirical evidence from VC contracts. Kaplan and Strömberg (2003), for example, find that VC-backed firms are more (less) likely to use ID-arbitration relative to entrepreneur control (investor control) when there is greater uncertainty regarding the project's financial viability, and as additional funds are invested. Furthermore, data on the appointment of independent directors show that they are mutually selected by "unanimous

consent” of the firm’s entrepreneurs and VC investors (Kaplan and Strömberg, 2003; Broughman, 2010), helping to ensure that an independent director’s interests are not captured by either party.

This study relates to the incomplete contracting literature on the optimal allocation of control rights. Grossman and Hart (1986) show that decision rights can affect relation-specific investments and should be allocated to minimize underinvestment. Emphasizing a tradeoff between cash flows and private benefits, Aghion and Bolton (1992) find that control should be awarded to the entrepreneur whenever possible; however, investor control may be necessary to satisfy the investor’s financing constraint. The above papers are complemented by a number of studies, including Berglöf (1994), Hellmann (1998, 2006), Dessein (2005), Kirilenko (2001), Black and Gilson (1998), Marx (1998), Schmidt (2003), Yerramilli (2006), and Gompers (1995), which focus on the allocation of control in VC-backed firms. These studies generally treat control as an indivisible right that can be held at any given time by only one party – either the entrepreneur or the VC investor.<sup>4</sup> My study is similar to Aghion and Bolton (1992), in that the investor’s financing constraint determines the optimal allocation of control. However, unlike the existing literature I do not treat control as an indivisible right, but rather I model the incentives created by a form of shared control with a third-party independent director holding the tie-breaking vote.

The closest analogy to ID-arbitration in the literature is state-contingent control (Aghion and Bolton, 1992). Kaplan and Strömberg (2003) make this explicit:

We interpret the situation where neither the VC nor the founder is in control as similar to state-contingent control. For example, in boards where [independent] board members are pivotal, it seems plausible that these members will vote with the VC as founder performance declines.

This description treats the independent director’s endorsement as a signal that transfers control between the entrepreneur and VC depending on the firm’s performance. It overlooks, however, the dynamic incentives created by ID-arbitration. Under ID-arbitration, even if a firm is performing well, the entrepreneur does not have absolute authority to pursue any action she desires; she

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<sup>4</sup> Two notable exceptions are (i) Yerramilli (2006), who shows that joint control coupled with a harsh penalty if the entrepreneur and VC fail to reach an agreement may be preferable to unilateral control, and (ii) Meyersson Milgrom et al. (2007), who model joint control arising from equityholder veto rights over specific classes of decisions. These studies, however, apply to a form of shared control which requires consent of both parties, and they do not address the use of third party independent directors.

still needs to propose actions that are likely to win the independent director's support.

State-contingent control and ID-arbitration are conceptually distinct.<sup>5</sup> State-contingent control determines *who* gets to decide the firm's action, whereas ID-arbitration is a *three-party* decision-making process. State-contingent control requires an ex post verifiable signal correlated with the state of nature, while ID-arbitration requires a third party whose preferences are independent of the entrepreneur and investor. The potential benefit of ID-arbitration is emphasized in circumstances where it is impossible to contract over the state of nature. ID-arbitration can be seen as a mechanism for turning a non-contractible variable (the state of nature) into a contractible variable (the independent director's vote) for specifying corporate actions ex post. My goal is not to compare state-contingent control and ID-arbitration, but rather to show that ID-arbitration is a distinct governance mechanism<sup>6</sup> and to model the incentives created by this allocation of board control. Since ID-arbitration is the most common allocation of board control in VC-backed firms, it is important to understand the incentives created by this arrangement.

This project also contributes to the broader literature on holdups. Contracting parties may be reluctant to make relationship-specific ex ante investments when there is risk of ex post holdup by the other party (Hart and Moore, 1988; Williamson, 1979). The literature suggests several solutions to the holdup problem.<sup>7</sup> Of particular relevance, the contract can use various mechanisms – specific performance (Aghion et al., 1994; Edlin and Reichelstein, 1996) or an option strike price (Noldeke and Schmidt, 1995) – to modify the default point if ex post

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<sup>5</sup> This distinction is particularly relevant whenever the independent director prefers an action that neither the entrepreneur nor the investor would select if given control. Under this scenario ID-arbitration creates an incentive for compromise that is not present under state-contingent control.

<sup>6</sup> To further illustrate this distinction note that ID-arbitration and state-contingent control are not mutually exclusive. The financing contract may call for ID-arbitration as the normal board arrangement but specify that the VCs will acquire additional board seats if the firm fails to meet certain performance targets, effectively shifting from ID-arbitration to VC-control in bad states of nature. Kaplan and Strömberg (2003:288) find evidence supporting the simultaneous use of ID-arbitration and State-contingent control: shared board control declines (61–52%) and VC control increases (25–36%) in the adverse state. Approximately 10% of VC-backed firms appear to use both ID-arbitration and State-contingent control simultaneously.

<sup>7</sup> In addition to mechanisms discussed above, contracting parties can prevent holdups though an ex post message game (Maskin and Tirole, 1999) or renegotiation design (Aghion et al., 1994).

renegotiation breaks down. By adjusting the default point, the contract can change each party's threat position entering renegotiation, potentially reducing or eliminating the risk of holdup.

My analysis extends the existing literature to intra-firm holdups between an entrepreneur and an investor. ID-arbitration can be seen as a mechanism for adjusting a firm's default choice of action. Without an independent director, the controlling party can use its position opportunistically, causing the firm to pursue actions that benefit it at the expense of aggregate welfare. By contrast, under ID-arbitration the parties commit to follow the independent director's preferred action whenever renegotiation breaks down. While this does not necessarily lead to the first-best, modifying the default point in this way can reduce the threat of holdup and potentially expand the range of startup firms that receive external financing.

Finally, it is worth noting two practical limitations. First, the potential benefits of ID-arbitration are constrained by various factors, including the cost of adding a new director, lack of impartiality, risk of collusion, and unpredictability regarding the independent director's behavior. Analogizing to empirical studies of publicly traded firms, the impact of independent directors on firm performance is unclear (Bhagat and Black, 2002). While I address some of these concerns below, my primary goal is to show that ID-arbitration is an alternative contractual mechanism that may be useful in an incomplete contract setting, not to suggest that it always leads to the efficient outcome. Second, arbitrating intra-firm conflicts is not the only, nor is it a mutually exclusive, explanation for the presence of independent directors in startup firms. Independent directors may also help monitor management (Gordon, 2007), provide advice (Mace, 1971), and signal the quality of the firm to outside parties (Deutsch and Ross, 2003). While such alternative explanations give us a better sense of the various ways, an independent director can add value, they cannot explain the fact that independent directors typically hold a tie-breaking position on the board. I do not try to explain the use of independent directors generally. Rather, I limit my analysis to the incentives created by ID-arbitration as opposed to entrepreneur control or investor control.

The remainder of this article is organized as follows. Section 2 describes the model and its underlying assumptions. Section 3 models entrepreneur and investor control, extending the results from Aghion and Bolton (1992) to a continuous action space. Section 4 describes and models bargaining under ID-arbitration. This section also expands the model to consider (i) side-payments to the independent director (i.e., collusion) and (ii) the effect of uncertainty on ID-arbitration. Section 5 considers data on board configurations and independent director appointment rights in startup firms. Section 6 concludes.

## 2 Model setup

Consider the following financial contracting problem. A risk-neutral entrepreneur (E) with no initial wealth needs funds  $K > 0$  to start a new venture. Financing can be obtained from a risk-neutral investor (V) who has unlimited resources. Consistent with the VC-contracting literature, the number of other entrepreneurs with worthwhile projects is limited, but there are many parties competing to finance such projects (Aghion and Bolton, 1992). Consequently, E has all the bargaining power and can make a take-it-or-leave-it offer to V. The contract must promise an expected return of at least  $K$  to satisfy V's participation constraint. I assume that investment is socially desirable and feasible for at least some allocation of cash-flow and control rights.

After investment the parties choose an action,  $a$ , from a compact action set,  $A = [a_b, a_y]$ . The optimal choice of action depends on the state of nature,  $\theta$ , which is realized after investment. Following Grossman and Hart (1986) and Aghion and Bolton (1992) I model contractual incompleteness by assuming that the state of nature is impossible to describe in the ex ante contract, but can be observed by the parties after realization. The choice of action cannot be contracted over ex ante.<sup>8</sup> Instead, the allocation of control rights (i.e., board seats) determines who gets to select  $a$ . The parties can renegotiate the choice of action after the state of nature has been realized. Similar to the ex ante contract, I assume that E has all the bargaining power in any ex post renegotiation.<sup>9</sup>

The basic setup for my model is similar to Aghion and Bolton (1992) except for two important distinctions. First, my model uses a continuous action space, illustrating the potential for compromise. Second, I assume, similar to Grossman and Hart (1986), that there are no verifiable signals that correlate with  $\theta$ . This

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<sup>8</sup> As noted by Maskin and Tirole (1999) this type of contractual incompleteness could in theory be circumvented by ex post message games. While I acknowledge this limitation of the incomplete contracting literature, the structured bargaining game that I model in Section 4 generates the first-best outcome under various parameter values, removing any need for ex post messaging.

<sup>9</sup> This assumption, also used in Aghion and Bolton (1992), can affect the ex ante feasibility of each governance arrangement; however, this paper's main results do not depend on the distribution of bargaining power or even the availability of renegotiation. In fact, if renegotiation were unavailable or costly, the benefits of ID-arbitration would be increased relative to E-control and V-control (see discussion in Section 4).



assumption rules out state-contingent control and lets me focus on ID-arbitration as a distinct mechanism.

To emphasize the importance of board control, I assume the parties must form a corporation (the “Firm”) to pursue the project, and that each action in  $A$  – whether or when to sell the firm, hire a new CEO, etc. – requires majority rule board authorization to be implemented. Furthermore, the composition of the Firm’s board is endogenous to the initial financing contract (Hermalin and Weisbach, 2003).

The project yields two types of benefits: a monetary benefit,  $y(a, \theta)$ , which can be verified and contractually allocated between the parties; and a private benefit,  $b(a, \theta)$ , which goes exclusively to E and is non-verifiable and non-transferable. Both benefits depend on the state of nature,  $\theta$ , and the choice of action,  $a$ . The investor cares only about the project’s monetary returns, while the entrepreneur cares about monetary returns as well as private benefits, such as personal satisfaction, the joy of running a family business, or being her own boss, etc. I assume that the parties can contractually divide the monetary returns, by giving  $\pi y(a, \theta)$  to E and giving  $(1 - \pi)y(a, \theta)$  to V, where  $\pi \in [0, 1]$ . The parties’ respective utility functions can be expressed as:

$$U_E(a, \theta, \pi) = \pi y(a, \theta) + b(a, \theta) \quad [1]$$

$$U_V(a, \theta, \pi) = (1 - \pi)y(a, \theta) \quad [2]$$

The project’s aggregate social utility is the sum of  $y$  and  $b$  and can be expressed as:

$$U(a, \theta) = y(a, \theta) + b(a, \theta) \quad [3]$$

To illustrate the conflict between the parties I assume that  $y$  is increasing in  $a$  while  $b$  is decreasing in  $a$  for all  $a \in A$ . As a result the endpoints of the action set,  $a_b$  and  $a_y$ , represent maximizing values for  $b(a, \theta)$  and  $y(a, \theta)$  respectively. To ensure a unique interior-optimum I also assume that  $b$  and  $y$  are both differentiable and concave in  $a$  and  $\frac{\partial y}{\partial a}(a_y) = \frac{\partial b}{\partial a}(a_b) = 0$  for all  $\theta$ . The efficient action, denoted by  $a^*$ , depends on the state of nature and can be expressed as

$$a^*(\theta) = \operatorname{argmax}_{a \in A} \{y(a, \theta) + b(a, \theta)\} \quad [4]$$

The allocation of control rights is important here, since it can affect the choice of action. If E has control she has incentive to pick  $\bar{a}_E$  such that<sup>10</sup>:

$$\bar{a}_E(\theta, \pi) = \operatorname{argmax}_{a \in A} \{\pi y(a, \theta) + b(a, \theta)\} \quad [5]$$

If V has control he has incentive to pick  $\bar{a}_V$  such that:

$$\bar{a}_V(\theta) = \operatorname{argmax}_{a \in A} (1 - \pi)y(a, \theta) \quad [6]$$

Given that  $y$  is increasing in  $a$  while  $b$  is decreasing in  $a$ , it follows that  $\bar{a}_E < a^* < \bar{a}_V$ .<sup>11</sup> Absent renegotiation, neither party has an incentive to pursue the efficient action.

The timing of events is as follows. At date 0 the parties enter a contract specifying the division of cash-flow rights  $\pi$  and the allocation of board control. At date 1 the state of nature  $\theta$  is revealed. The parties can “renegotiate” the choice of action between date 1 and date 2.<sup>12</sup> At date 2 the firm implements the selected action  $a$ . At date 3 monetary returns and private benefits are realized and the contract is executed. The time structure of the model is summarized in Figure 1.

At the time of investment, the parties contract over only two parameters: the allocation of cash-flow rights (represented by  $\pi$ ) and the allocation of board control. To simplify the analysis of cash-flows I assume that the parties share monetary returns in a linear manner,  $\pi y$  to E and  $(1 - \pi)y$  to V.<sup>13</sup> The conflict

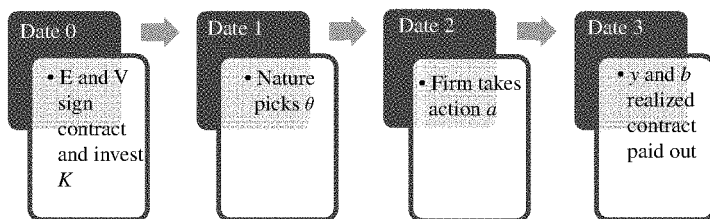
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**10** My analysis throughout this paper assumes that each non-independent director will act in the interests of the constituency – investor or entrepreneur – that he represents. This view is potentially at odds with corporate law, under which directors have a fiduciary obligation to serve the best interests of the corporation and its stockholders. In VC-backed firms, however, fiduciary obligations place little constraint on opportunistic behavior (Fried and Ganor, 2006), suggesting it is reasonable to ignore this legal constraint. Alternatively, the action set  $A$  can be thought of as the set of actions consistent with these legal obligations.

**11** If E were allocated all of the monetary returns (i.e. if  $\pi = 1$ ) then  $\bar{a}_E = a^*$  and E would choose the optimal action; however, this would necessarily violate V’s individual rationality constraint.

**12** The parties cannot contract over future actions at date 0. Thus technically, they are negotiating the choice of action for the first time after date 1. However, following the literature I refer to this as “renegotiation” throughout the paper, emphasizing that this bargaining occurs after the original contract and after the state of nature is revealed.

**13** In practice VCs typically hold convertible preferred stock, while entrepreneurs hold common stock (Kaplan and Stromberg, 2003). Potential conflicts can arise between preferred stock and common stock (Fried and Ganor, 2006; Hellmann, 2006; Broughman and Fried, 2010), and a tiebreaking independent director may be desirable in this context as well. However, because preferred stock is endogenous to the financing contract I focus instead on the more basic tradeoff between private benefits and financial returns. The same intuition, however, should extend to other conflicts that may arise in a startup firm.



**Figure 1:** Timeline.

between E and V is driven by non-transferable private benefits rather than different cash-flow rights.

The parties contract over three possible allocations of board control: (i) E-control, (ii) V-control, and (iii) ID-arbitration. In the first two cases either the entrepreneur or the investor, respectively, controls a strict majority of the board seats and can use this position to unilaterally select the firm's action, which can be renegotiated immediately prior to implementation.

Under ID-arbitration the choice of action is the result of deliberation and voting among the three directors. To specify the result of such deliberation, I assume a structured bargaining process similar to final offer arbitration (Stevens, 1966). Section 4 provides a detailed description of the structured bargaining game and its underlying assumptions.

### 3 Allocations of board control without an independent director

Before considering ID-arbitration in more detail, however, I first describe E-control and V-control. This section is a variation of Aghion and Bolton (1992) extended to a continuous action space.<sup>14</sup>

#### 3.1 E-control

Under E-control the entrepreneur has an incentive to select  $\bar{a}_E$ , even though  $U(\bar{a}_E) < U(a^*)$ . To solve this problem, the parties will renegotiate. E will offer to

<sup>14</sup> For ease of presentation I drop most references to  $\theta$  and  $\pi$  from the notation in the following sections, except where needed for clarification. For example,  $\bar{a}_E$  will be used instead of  $\bar{a}_E(\theta, \pi)$ .

choose  $a^*$  instead of  $\bar{a}_E$  in exchange for a payment equal to  $(1 - \pi)[y(a^*) - y(\bar{a}_E)]$ , which is V's benefit from the renegotiation. After renegotiation E's payoff can be expressed as:

$$\begin{aligned} U_E &= \pi y(a^*) + b(a^*) + (1 - \pi)[y(a^*) - y(\bar{a}_E)] \\ &= U(a^*) - U_V(\bar{a}_E) \end{aligned} \quad [7]$$

$$> U(\bar{a}_E) - U_V(\bar{a}_E) = U_E(\bar{a}_E) \quad [8]$$

E's payoff after renegotiation [7] is greater than her payoff pre-renegotiation [8], since  $U(a^*) > U(\bar{a}_E)$ . V will accept E's renegotiation offer since the change in action benefits V enough to justify the payment, leaving V indifferent between the two alternatives:

$$U_V = (1 - \pi)y(a^*) - (1 - \pi)[y(a^*) - y(\bar{a}_E)] \quad [9]$$

$$= (1 - \pi)y(\bar{a}_E) = U_V(\bar{a}_E) \quad [10]$$

As a consequence of renegotiation, E-control will always lead to the efficient outcome.

The problem, however, is that under E-control, the Firm may be unable to pledge sufficient monetary returns to V. To satisfy V's participation constraint the following relationship must hold for some  $\pi \in [0, 1]$ :

$$EU_V(\bar{a}_E) \geq K \quad [11]$$

When the inequality in eq. [11] does not hold for any  $\pi \in [0, 1]$ , V will be unwilling to invest under E-control. An alternative governance arrangement is necessary to satisfy V's participation constraint.

**Proposition 1:** *E-control will always lead to the first-best outcome,  $a^*$ , through renegotiation; however, E-control is not feasible unless  $EU_V(\bar{a}_E) \geq K$  for some  $\pi \in [0, 1]$ .*

### 3.2 V-control

Under V-control, the firm is able to pledge additional monetary returns to V. This follows since  $y(\bar{a}_V) > y(\bar{a}_E)$  for any allocation of cash-flow rights. V-control can satisfy the investor's participation constraint, since  $K \leq Ey(\bar{a}_V)$  by assumption.<sup>15</sup>

<sup>15</sup> We assume that investment is feasible for at least some allocation of cash-flow and control rights. Since  $\bar{a}_V$  maximizes the Firm's monetary returns it is equivalent to say that  $K < E_y(\bar{a}_V)$ .

The controlling investor, however, will ignore the entrepreneur's private benefits.  $V$  has an incentive to select  $\bar{a}_V$ , an inefficient outcome. Renegotiation could improve the result, but renegotiation under  $V$ -control is problematic.  $E$  has zero wealth and may be unable to bribe  $V$  into selecting an alternative action. Technically  $E$  could give up her share,  $\pi$ , of the Firm's monetary returns. Depending on the realization of  $\theta$ , however, this may be insufficient to induce  $V$  to pursue the optimal action. To reach the first-best  $E$  must pay  $V$  at least  $(1 - \pi)[y(\bar{a}_V) - y(a^*)]$ . This payment is only possible if, after realizing  $\theta$ , the following relationship holds:

$$y(a^*) \geq (1 - \pi)y(\bar{a}_V) \quad [12]$$

If renegotiation to the first-best is possible,  $E$ 's payoff after renegotiation would be  $U(a^*) - U_V(\bar{a}_V)$ . Similar to the previous section,  $V$ 's payoff will remain the same before and after renegotiation.

When eq. [12] does not hold,  $E$  cannot pay  $V$  enough to induce the first-best; however, provided  $\pi \neq 0$ , the parties can still renegotiate to an intermediate action, between  $a^*$  and  $\bar{a}_V$ . Since  $A$  is a compact set and  $y$  is continuous and increasing in  $a$ , there exists  $\tilde{a}$  such that  $a^* < \tilde{a} < \bar{a}_V$  and  $y(\tilde{a}) = (1 - \pi)y(\bar{a}_V)$ .  $E$  will propose  $\tilde{a}$  in the renegotiation game and offer to pay  $(1 - \pi)[y(\bar{a}_V) - y(\tilde{a})]$ ,  $V$  will accept this offer, since  $E$ 's payment fully compensates him for the change in action. This limited form of renegotiation makes  $E$  better off than no renegotiation, but it does not lead to the efficient outcome. The magnitude of expected inefficiency under  $V$ -control depends on the distribution of  $\theta$ . The above analysis can be summarized in the following proposition.

**Proposition 2:**  *$V$ -control is always feasible, since  $K \leq Ey(\bar{a}_V)$  by assumption. However, for some  $\theta$ ,  $V$ -control will not lead to the first-best since renegotiation is limited by  $E$ 's wealth constraint.*

### 3.3 Limitations of E-control and V-control

Propositions 1 and 2 illustrate a tradeoff between ex post efficiency and pledgeable income.  $E$ -control ensures an ex post efficient outcome; however, the Firm can only pledge to the investor expected monetary returns equal to  $Ey(\bar{a}_E)$ . If the amount invested is greater than this,  $E$ -control would violate  $V$ 's participation constraint. Moving to  $V$ -control increases the monetary returns that the firm can pledge to the investor, but compromises the project's overall value. Under  $V$ -control the investor will ignore the entrepreneur's private benefits, and the

parties may be unable to renegotiate to the efficient outcome due to E's wealth constraint.

Limiting our analysis to E-control and V-control, this tradeoff suggests a natural progression. Use E-control whenever eq. [11] holds, and use V-control when it does not. The problem is that this may lead to a suboptimal outcome whenever V-control is needed. The question is whether ID-arbitration can improve ex post efficiency without violating V's participation constraint.

## 4 Independent director arbitration

I model decision-making under ID-arbitration with a structured bargaining process similar to final offer arbitration. E and V will each propose an action, denoted by  $a_E$  and  $a_V$  respectively. If  $a_E = a_V$  there is no disagreement and the Firm will pursue this action; however, if  $a_E \neq a_V$  the independent director must choose between the two proposals. Similar to final offer arbitration, the independent director (i.e., the arbitrator) cannot introduce a compromise, but must simply pick between  $a_E$  and  $a_V$ . This bargaining process reflects the fact that ID is not one of the primary parties and is likely to play a more passive role in management than the entrepreneur or VC. It also ensures that the Firm's action is supported by at least two out of the three board members.

If asked to arbitrate, ID will select his preferred proposal. For serving on the board, I assume ID is paid a flat fee (no residual interest in the Firm's choice of action), and he may also receive access to valuable information relevant to the industry.<sup>16</sup> ID would like to be appointed to the board of other firms in the future to continue receiving such benefits. To protect this stream of future benefits, the ID must consider his reputation among both entrepreneurs and investors. The

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<sup>16</sup> I do not explicitly model the cost of adding an independent director to the board. Rather, the model below implicitly assumes zero cost. Even though the cost of an independent director would generally be quite small, this is an arguably unrealistic simplification. Alternatively, one could refine the model by stating that ID receives a fixed payment equal to  $C$  for agreeing to serve on the board. Because, the firm needs additional funds to pay the ID it follows that V's investment at Date 0 would increase to  $K+C$ . Similarly, under ID-arbitration V would demand a larger share of the cash flow rights, sufficient to give V an expected payoff of  $K+C$ . This refinement would not change the analysis associated with Propositions 3 and 4 below (only change is that " $K$ " would be replaced by " $K+C$ " throughout). This refinement would, however, complicate the comparative static results discussed in Section 4.5 and illustrated in Figure 2. The choice between ID-arbitration and V-control would not simply depend on the amount invested, but also on the cost of adding an independent director. See discussion in footnote 22 below for more details.

appointment process for IDs emphasizes this concern. In VC-backed firms, independent directors are selected by “unanimous consent” of the firm’s entrepreneurs and VC investors (Kaplan and Strömberg, 2003; Broughman, 2010). Consequently, IDs who develop a bad reputation among either group can be vetoed and are less likely to be appointed in the future. This point is confirmed by data on arbitrator selection in other contexts. Arbitrators who consistently favor one side to a dispute are more likely to be vetoed by the disfavored side, and thus less likely to serve as an arbitrator in the future (Bloom and Cavanagh, 1986). Independent directors have an incentive to resolve disputes in an impartial manner. Other considerations, however, such as business norms or a significant relationship with one of the two parties may cause an ID to favor one side over the other. In any event, an independent director’s choice between  $a_E$  and  $a_V$  is influenced by the importance of maintaining her reputation among both groups.

To model this, I assume that an ID considers the interests of E and V, with relative weight  $\tau \in [0, 1]$  assigned to E and  $(1 - \tau)$  to V. We can describe ID’s preference ordering as a linear combination of E and V’s respective utility. Let  $g(\tau, a, \theta) = \tau U_E(a, \theta) + (1 - \tau) U_V(a, \theta)$ . ID’s preferred outcome,  $\bar{a}_{ID} \in A$ , can be expressed as:

$$\bar{a}_{ID}(\tau, \theta) = \operatorname{argmax}_{a \in A} g(\tau, a, \theta) \quad [13]$$

If asked to arbitrate, ID will select the proposal,  $a_{ID} \in \{a_E, a_V\}$ , which maximizes  $g$ :

$$a_{ID}(a_E, a_V, \tau) = \begin{cases} a_E & \text{if } g(\tau, a_E) > g(\tau, a_V) \\ a_V & \text{if } g(\tau, a_E) < g(\tau, a_V) \end{cases} \quad [14]$$

If  $g(\tau, a_E) = g(\tau, a_V)$  the independent director is indifferent between the two proposals. In which case, she will flip a coin to decide which proposal to endorse.

The parameter  $\tau$  measures the relative importance of ID’s reputation among entrepreneurs as opposed to investors. If  $\tau = 1/2$  we can say that the ID is unbiased. By contrast if  $\tau > 1/2$  the ID is biased to favor E, and if  $\tau < 1/2$  the ID is biased to favor V. By definition there is a one-to-one monotonically decreasing mapping between  $\tau$  and  $\bar{a}_{ID}$ . When  $\tau = 1/2$  it follows that  $\bar{a}_{ID} = a^*$ , since  $g(.5, a) = .5U(a)$ . Given this relationship, we can also characterize bias by comparing  $\bar{a}_{ID}$  to  $a^*$ . ID is unbiased if  $\bar{a}_{ID} = a^*$ ; ID favors E if  $\bar{a}_{ID} < a^*$ ; and ID favors V if  $\bar{a}_{ID} > a^*$ .

For each ID,  $\tau$  is expressed in reduced form and treated as exogenous to the financing contract. This is obviously a simplification. E and V could alter

ID's interests by awarding her a fraction of the Firm's cash-flow rights. In practice, independent directors in VC-backed firms are often given a small share of common stock, but I am unaware of large awards that could have a significant impact on ID's behavior. By ruling this out, I am effectively assuming that giving ID high-powered financial incentives is not worth the cost to E or V.

Similar to the previous section, under ID-arbitration the parties can still renegotiate the choice of action after realization of  $\theta$ . E and V collectively hold a majority of the Firm's board seats and can thus renegotiate without needing to consult the ID. However, as is shown below, the ID remains important since her preferred outcome affects the parties' bargaining positions entering the renegotiation.

In this section I make two additional assumptions, both of which are relaxed in the analysis below. First, I assume that neither E nor V can bribe ID. This abstracts away from the problem of collusion that can arise in three-party bargaining (Tirole, 1986). Legal and reputational constraints provide some justification for this assumption. Corporate fiduciary obligations prohibit director vote buying.<sup>17</sup> To enforce this prohibition a court does not need to verify the underlying state of nature. Rather, a breach of the fiduciary duty of loyalty can be established by showing that a director received an improper benefit in connection with a particular corporate action (Clark, 1986). Put another way, as long as the court can verify side-payments to ID, it does not need to know the optimal corporate action,  $a^*$ , to prevent bribes. Whereas, to prevent opportunism under E-control or V-control a court would need to verify that the action which the controlling party causes the firm to pursue is not optimal. Fiduciary obligation may improve ID impartiality, while still being unable to curb all instances of opportunism by the primary parties.<sup>18</sup>

Even without legal enforcement, if an ID is caught taking a bribe or otherwise colluding with one of the primary parties, her reputation in the entrepreneur or investor community, whichever was harmed by the bribe, may be severely damaged, reducing the likelihood that such individual may serve as an independent director for other firms in the future. Similar to above, if

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<sup>17</sup> Collusion with another party would violate the director's fiduciary duty of loyalty.

<sup>18</sup> It should be noted that a particularly robust (and unrealistic) conception of fiduciary obligations would prevent all instances of ex post opportunism (Hart, 1993; Broughman, 2010). In practice, however, the business judgment rule prevents judicial review of most operational decisions, unless the decision-making process was tainted by self-dealing (Clark, 1986).



side-payments are verifiable but the efficient corporate action is not, reputation may limit collusion even though it is less effective at constraining opportunism under E-control and V-control.

Nonetheless, it may be unrealistic to assume that law or reputation prevents *all instances* of collusion. In some instances, for example, the primary parties may be able to camouflage bribes to the ID, effectively preventing legal or reputational sanction. Recognizing this concern, I relax the assumption against collusion in Section 4.3 and examine the effect that side-payments from V to ID might have on the firm's choice of action.

Second, I assume that E and V can observe ID's preference ordering and, similarly, that ID does not make any errors in selecting between  $a_E$  and  $a_V$ . The parties are in a long term relationship with ID and want to select an ID with predictable views. This assumption eliminates uncertainty and simplifies the analysis, but it may be unrealistic. To address this concern I expand the model to allow for uncertainty in Section 4.4.

The remainder of Section 4 models the incentives of ID-arbitration. Section 4.1 models the equilibrium proposals  $a_E$  and  $a_V$  without renegotiation. Section 4.2 considers how renegotiation may affect the outcome. Section 4.3 relaxes the assumption that an ID cannot be bribed. Section 4.4 expands the model to consider the effect of uncertainty. Section 4.5 compares ID-arbitration to the alternative governance arrangements.

## 4.1 ID-arbitration without renegotiation

Under ID-arbitration neither E nor V can unilaterally cause the Firm to pursue their preferred action. Instead, they must propose actions that would be endorsed by ID. To obtain ID's endorsement both E and V will propose actions converging upon the ID's preferred outcome. E has an incentive to set  $a_E = \bar{a}_{ID}$ , since any alternative proposal would make E worse off, either because  $a_E > \bar{a}_{ID}$ , or if  $a_E < \bar{a}_{ID}$  because E's proposal would lose at arbitration to some  $a_V > \bar{a}_{ID}$  where  $g(\tau, a_E) < g(\tau, a_V)$ . For similar reasons V also has an incentive to set  $a_V = \bar{a}_{ID}$ . In equilibrium  $a_E = a_V = \bar{a}_{ID}$  and there is no disagreement to be arbitrated. The intuition behind this result is similar to economic models of bargaining under final offer arbitration (Crawford, 1979) and the median voter theorem from political science (Downs, 1957; Calvert, 1985). In each case the disputing parties (political candidates) have an incentive to propose the action (platform) most preferred by the arbitrator (median voter). The following proposition shows, without renegotiation, convergence toward ID's preferred action.

**Proposition 3:** *If E and V can observe  $\tau$  and renegotiation is unavailable, then:*

- (i) *In a firm under ID-arbitration  $a_E = a_V = \bar{a}_{ID}$  is the unique Nash equilibrium; and*
- (ii) *Investment under ID-arbitration is feasible if and only if  $K \leq Ey(\bar{a}_{ID})$ .*

**Proof:** See Appendix.

Proposition 3 illustrates two immediate benefits to ID-arbitration. First, by converging upon  $\bar{a}_{ID}$  the parties are able to reach a compromise solution, between  $\bar{a}_E$  and  $\bar{a}_V$ , without renegotiation. The benefit of this compromise is clearest when ID is unbiased (i.e., when  $\bar{a}_{ID} = a^*$ ), since in this case the parties will converge directly upon the ex post efficient outcome.

Second, ID-arbitration may be feasible in circumstances where E-control would violate V's participation constraint. E-control is only feasible if  $K \leq E(1 - \pi)y(\bar{a}_E)$  for some  $\pi \in [0, 1]$ , whereas ID-arbitration is feasible whenever  $K \leq Ey(\bar{a}_{ID})$ . Since  $(1 - \pi) \leq 1$  and  $y(\bar{a}_E) \leq y(\bar{a}_{ID})$  for all  $\tau$ , it follows that there is a range of investments for which ID-arbitration is feasible but E-control is not. This occurs whenever, for all  $\pi \in [0, 1]$  there is an ID such that:

$$E(1 - \pi)y(\bar{a}_E) < K \leq Ey(\bar{a}_{ID}) \quad [15]$$

Without an ID, such firms would have to be operated under V-control, potentially leading to an inefficient outcome (even with renegotiation).

If eq. [15] holds and the parties can find an unbiased ID, then the firm can reach the efficient outcome under ID-arbitration, but not under the alternative governance arrangements. Proposition 3 also shows, however, that without renegotiation a biased ID would lead to an inefficient outcome. The next section considers how renegotiation under ID-arbitration might address this.

## 4.2 Renegotiation under ID-arbitration

Under ID-arbitration renegotiation is desirable whenever ID is biased. The type of renegotiation, however, depends on whether the ID is biased to favor the entrepreneur or the investor (i.e., whether  $\bar{a}_{ID}$  is less than or greater than  $a^*$ ).

When  $\bar{a}_{ID} < a^*$  the entrepreneur prefers  $\bar{a}_{ID}$  to  $a^*$ , and will only agree to the first-best if she receives a sufficient payment from V. In particular, E will propose  $a^*$  in exchange for a payment equal to  $(1 - \pi)[y(a^*) - y(\bar{a}_{ID})]$ . Similar to above, this payment will give the entire surplus from renegotiation to E. V will agree to the renegotiation since the change in action exactly offsets the

payment. When  $\bar{a}_{ID} < a^*$  ID-arbitration will always lead to the efficient outcome through renegotiation between E and V.

By contrast, when  $\bar{a}_{ID} > a^*$  the investor prefers  $\bar{a}_{ID}$  to  $a^*$ . The investor will only agree to the first-best if he receives a sufficient payment from E. Renegotiation in this direction, however, is limited by E's lack of wealth. This is the same problem that we considered in Section 3.2 above. Even though E has no wealth she can give up her share of the Firm's monetary returns. To reach the first-best E must pay V at least  $(1 - \pi)[y(\bar{a}_{ID}) - y(a^*)]$ . This payment is only possible if, after realizing  $\theta$ , the following relationship holds:

$$y(a^*) \geq (1 - \pi)y(\bar{a}_{ID}) \quad [16]$$

When eq. [16] does not hold, E cannot pay V enough to induce the first-best; however, similar to the discussion of renegotiation under V-control, the parties can still renegotiate to an intermediate action, between  $a^*$  and  $\bar{a}_{ID}$  (assuming  $\pi \neq 0$ ). When  $\bar{a}_{ID} > a^*$  renegotiation is potentially limited by E's wealth constraint.

While renegotiation can affect the action pursued under ID-arbitration, it has no effect on V's participation constraint. By assumption E has all the bargaining power and captures the entire surplus from any renegotiation. Consequently V's welfare is unaffected. V's participation constraint is only satisfied if the expected monetary returns from ID's preferred action are greater than the ex ante investment. Thus, ID-arbitration remains feasible if and only if  $K \leq Ey(\bar{a}_{ID})$ . The above analysis of renegotiation under ID-arbitration is summarized in the following proposition.

**Proposition 4:** *In a firm under ID-arbitration, if E and V can renegotiate, the outcome depends on the relationship between  $\bar{a}_{ID}$  and  $a^*$ :*

- (i) *If  $\bar{a}_{ID} = a^*$  the Firm will pursue the first-best outcome without renegotiation,*
- (ii) *If  $\bar{a}_{ID} < a^*$  the Firm will pursue the first-best outcome following renegotiation between E and V, and*
- (iii) *If  $\bar{a}_{ID} > a^*$ , for some  $\theta$ , the Firm may not pursue the first-best outcome since renegotiation is limited by E's wealth constraint; and*

*The feasibility of ID-arbitration is unaffected by renegotiation. Investment under ID-arbitration remains feasible if and only if  $K \leq Ey(\bar{a}_{ID})$ .*

With renegotiation the efficiency of ID-arbitration does not necessarily depend on finding an unbiased ID. As long as ID is not biased in favor of V, the parties can always renegotiate to the efficient outcome. Regardless whether renegotiation occurs, ID-arbitration may be feasible in circumstances where E-control would not.

### 4.3 Robustness to bribes

In this section I relax the assumption that the parties cannot bribe ID to obtain his support. Suppose there is an imperfect legal/reputation constraint, observable to all parties, such that ID risks facing a penalty with expected cost equal to  $d > 0$  whenever he accepts a side payment. This differs from above in that the legal/reputational penalty is not an absolute barrier to collusion, but merely a cost. ID will accept a bribe if offered a side-payment greater than  $d$ , but not otherwise.

Since E is wealth constrained, I limit my analysis to bribes from V to ID. I am effectively assuming that E cannot borrow funds to bribe ID. This simplifies the analysis. I also think it reflects a realistic asymmetry between E and V's relative ability to influence an ID. As above, E and V both propose actions,  $a_E$  and  $a_V$  respectively, but now V can also add a side-payment to encourage acceptance of its proposed action. To further simplify the bargaining game I assume that E will first propose  $a_E$ . Then, after observing E's proposal, V will propose  $a_V$ . V has the option of including a side-payment to encourage acceptance of its proposed action.

Given this setup, if V offers a side-payment it will be coupled with  $\bar{a}_V$ , V's preferred action. Since the cost of a bribe does not depend on the action proposed, V has no reason to moderate its proposal when offering a bribe. Recognizing this concern, E will adjust its initial proposal so that V does not have reason to include a side-payment with its proposed action. Namely, E will propose  $a_E = \max(\bar{a}_{ID}, a_E^d)$  where  $a_E^d \in A$  such that  $y(a_E^d) = y(\bar{a}_V) - d$ . In words, E will either propose ID's preferred action ( $\bar{a}_{ID}$ ), or E will move closer to V's preferred action so that V no longer has an incentive to bribe ID. In either case, V will agree to E's proposed action, since E's proposal removes any incentive to actually bribe ID. The parties may renegotiate, similar to the analysis in Section 4.2, but now each party's threat position entering the renegotiation is set equal to  $\max(\bar{a}_{ID}, a_E^d)$  instead of to  $\bar{a}_{ID}$  as was the case in Section 4.2.

The ability to bribe ID undermines the potential benefit of ID-arbitration, particularly if there is a weak legal/reputational constraint (i.e.,  $d$  is close to zero). ID-arbitration effectively collapses into V-control as  $d$  goes to 0. As the cost of bribing ID goes to zero he effectively turns into another investor representative on the board. Conversely, if there is a strong legal /reputational constraint (i.e.,  $d$  is sufficiently large) the threat of a bribe disappears and ID-arbitration behaves as described in Sections 4.1 and 4.2 above. As long as there is at least some legal/ reputational risk to accepting a bribe, ID-arbitration allows the parties to commit to an interior solution between  $\bar{a}_E$  and  $\bar{a}_V$ . Though its benefits may be muted, ID-arbitration can still moderate the threat of holdup even if V is able to bribe ID.

#### 4.4 Robustness to uncertainty

The model described above assumes the parties can observe ID's preference ordering. It also assumes that ID does not make any errors in selecting between  $a_E$  and  $a_V$ . In this section I relax both assumptions by introducing uncertainty.

Uncertainty is more realistic in two important respects. First, it captures the fact that neither E nor V can perfectly observe  $\tau$  or  $\bar{a}_{ID}$ . Second, it also captures the possibility that ID may simply make errors if asked to arbitrate. In the latter case, even if  $\tau$  and  $\bar{a}_{ID}$  were known to the primary parties, the ID may mistakenly conclude that a proposal generating a lower value in  $g$  should win. Introducing uncertainty over  $\tau$  (or equivalently over  $\bar{a}_{ID}$ ) can address both concerns.

With uncertainty, convergence to ID's preferred action is no longer a Nash equilibrium, and the divergence between E and V's respective proposals increases with the amount of uncertainty. This is modeled in the literature on final offer arbitration (Farber, 1980; Brams and Merrill, 1983), and in the political science literature on electoral competition between policy motivated candidates (Wittman, 1977; Calvert, 1985). While these settings are somewhat different, both sets of models assume that the distribution of uncertainty is common knowledge to the disputing parties (candidates). Brams and Merrill (1983) find a non-convergent Nash equilibrium, where the equilibrium proposals are centered on the median (i.e.,  $E\bar{a}_{ID}$ ), but some distance away from it on each side. Calvert (1985) shows that the degree of divergence increases with the amount of uncertainty. Since these results are proved in the literature I will not reproduce them here. Rather, I simply illustrate how uncertainty could affect the bargaining game.<sup>19</sup> To use a near-worst case scenario, I assume that ID's preferred outcome is distributed uniformly over the action set.

Let  $A = [0, 1]$ . I assume that  $\bar{a}_{ID}$  is uniformly distributed over  $A$ , and the distribution of  $\bar{a}_{ID}$  is common knowledge to E and V. At date 2, the parties' respective objective functions are:

$$U_V(a) = 1 - (1 - a)^2 \quad [17]$$

$$U_E(a) = 1 - a^2 \quad [18]$$

For this example, the first-best action,  $a^* = 1/2$ , while E and V have an incentive to pursue  $\bar{a}_E = 0$ , and  $\bar{a}_V = 1$ . Furthermore, given a uniform distribution, it follows that ID is unbiased in expectation (i.e.,  $E\bar{a}_{ID} = 1/2 = a^*$ ).

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<sup>19</sup> This example is suggested by McCarty and Meirowitz (2007) at pages 105–107.

For any two proposals,  $a_E$  and  $a_V$ , E wins whenever the realized value of  $\bar{a}_{ID}$  is closer to  $a_E$ , and loses when it is closer to  $a_V$ .<sup>20</sup> Since  $\bar{a}_{ID}$  is distributed uniformly over  $[0, 1]$  it follows that  $a_E$  is chosen by ID with probability  $(a_E + a_V)/2$  when  $a_E < a_V$ , and with probability  $1 - [(a_E + a_V)/2]$  when  $a_E > a_V$ . The entrepreneur and investor's expected utilities, with  $\bar{a}_{ID}$  distributed uniformly, can be expressed as:

$$EU_E(a_E, a_V) = \begin{cases} U_E(a_E)((a_E + a_V)/2) + U_E(a_V)(1 - (a_E + a_V)/2) & \text{if } a_E < a_V \\ U_E(a_V)((a_E + a_V)/2) + U_E(a_E)(1 - (a_E + a_V)/2) & \text{if } a_E > a_V \end{cases} \quad [19]$$

$$EU_V(a_E, a_V) = \begin{cases} U_V(a_E)((a_E + a_V)/2) + U_V(a_V)(1 - (a_E + a_V)/2) & \text{if } a_E < a_V \\ U_V(a_V)((a_E + a_V)/2) + U_V(a_E)(1 - (a_E + a_V)/2) & \text{if } a_E > a_V \end{cases} \quad [20]$$

Given this setup, what actions will E and V propose, absent renegotiation? We solve for Nash equilibrium  $(a_E, a_V)$  in the following proposition.

**Proposition 5:** *In a firm under ID-arbitration, with  $\bar{a}_{ID}$  distributed uniformly over the action set  $A = [0, 1]$ , and with  $U_V$  and  $U_E$  as stated in eqs. [17] and [18] respectively, there is a unique pure strategy Nash equilibrium where  $a_E = 1/4$  and  $a_V = 3/4$ .*

**Proof:** See Appendix.

In earlier sections, when E and V could observe  $\tau$  (and thus  $\bar{a}_{ID}$ ) directly, there was no benefit and a potential cost to proposing anything other than  $\bar{a}_{ID}$ . By contrast, when uncertainty is introduced, both parties benefit (at the expense of the other) by proposing an action closer to their ideal. Essentially, the parties are willing to trade off a small loss in the probability of having their proposal selected by ID, for a gain in the event that their proposal is selected by ID. Consequently, both parties move away from  $E\bar{a}_{ID} = .5$  and toward their preferred action. In the current example both proposals move an equal distance away from  $E\bar{a}_{ID}$ , and each party expects to win at arbitration half the time.

This divergent equilibrium is not optimal behavior. The first-best action,  $a^* = 1/2$  gives both E and V an expected payoff of  $12/16$  (i.e.,  $y(a^*) = b(a^*) = 12/16$ ). From eqs. [19] and [20], however, we find that the

<sup>20</sup> In this example, the ID's preference ordering (i.e.  $g$ ) is symmetric about its optimum (i.e.  $g(\tau, \bar{a}_{ID} + \varepsilon) = g(\tau, \bar{a}_{ID} - \varepsilon)$  for any  $\varepsilon > 0$ ). Consequently, we can simply consider the distance between each proposal and  $\bar{a}_{ID}$  to determine the selected proposal.

Nash equilibrium ( $a_E = 1/4, a_V = 3/4$ ) gives both parties a lower expected payoff, equal to  $11/16$  for both E and V. Uncertainty can cause a loss of efficiency even if the ID is unbiased in expectation.

There is an incentive for E and V to renegotiate. Similar to above, E has all the bargaining power in the renegotiation. In this example E will agree to pursue  $a^*$  in exchange for a payment of  $1/16$  from V. This would allocate the entire surplus from renegotiation to E, giving E an expected payoff of  $13/16(b(a^*) + 1/16 = 13/16)$ . V will agree to the renegotiation since the change in action benefits V enough to justify the payment, leaving V indifferent ( $y(a^*) - 1/16 = 11/16$ ). With renegotiation, uncertainty will not prevent the parties from reaching the efficient outcome.

Uncertainty can, however, make it harder to satisfy V's participation constraint. Because of uncertainty E can holdup V for additional payments in renegotiation. In this example, V's expected payoff after renegotiation is  $11/16$ . However, if uncertainty were removed, V's expected payoff would rise to  $12/16$ . This illustrates that the range of investments for which ID-arbitration is feasible can decrease when uncertainty is introduced. The magnitude of this problem depends on the expected distribution of  $\theta$  and the allocation of bargaining power between E and V. In some instances, uncertainty may make V unwilling to invest under ID-arbitration.

Despite this limitation, uncertainty does not undermine the basic benefits of ID-arbitration. Even with a uniform distribution, a severe form of uncertainty, the parties still propose compromise solutions that fall between  $\bar{a}_E$  and  $\bar{a}_V$ . In this respect, the magnitude of holdup caused by uncertainty is less than under E-control and V-control.

## 4.5 Comparison of ID-arbitration to alternative governance arrangements

ID-arbitration effectively allows a continuum of different control allocations, with E-control and V-control representing extreme ends of the spectrum. Without an independent director, the firm cannot commit to any action between the two extremes,  $\bar{a}_E$  and  $\bar{a}_V$ , favored by the entrepreneur and investor. This problem is not solved by state-contingent control, which merely leads to  $\bar{a}_E$  in some circumstances and  $\bar{a}_V$  in others. While the final action under E-control or V-control may be renegotiated, the points  $\bar{a}_E$  and  $\bar{a}_V$  are still relevant since they define each party's threat position entering the renegotiation, potentially leading to a significant holdup problem. Under E-control the threat of holdup may violate the investor's ex ante participation constraint. Under V-control the threat of holdup may lead to an inefficient action ex post.

By contrast, under ID-arbitration the parties can commit to an interior solution. By adding an independent director to the board, E and V effectively agree to follow the independent director's preferred outcome,  $\bar{a}_{ID}$ , whenever they disagree. The solution provided by ID-arbitration has some similarity to Aghion et al. (1994), Noldeke and Schmidt (1995), and Edlin and Reichelstein (1996) in which the contracting parties can set different default positions (e.g., specific performance) in the event that renegotiation fails. With ID-arbitration the default position is set equal to the ID's preferred outcome. This can reduce the threat of holdup in two ways.

First, from an ex post perspective, there is less need for renegotiation. This benefit is clearest when ID is unbiased (i.e., when  $\bar{a}_{ID} = a^*$ ), since in this case the parties will converge directly upon the efficient outcome. Even when ID is biased, however, the use of ID-arbitration can reduce the need for renegotiation, since each party can only demand to be compensated for the benefits she would have received if  $\bar{a}_{ID}$  were implemented, not for the larger personal benefit she would have received under her preferred action. While renegotiation may still occur, the renegotiation payment will be smaller.<sup>21</sup> Reducing the need for renegotiation is important since E's wealth constraint limits her ability to pay V ex post. Because of this concern ID-arbitration will lead to the first-best outcome in some circumstances where V-control would lead to an inefficient result.

Second, from an ex ante perspective, ID-arbitration may be feasible in circumstances where E-control would violate V's participation constraint. E-control is only feasible if  $K \leq E(1 - \pi)y(\bar{a}_E)$  for some  $\pi \in [0, 1]$ , whereas ID-arbitration, which generates greater monetary returns, is feasible whenever  $K \leq Ey(\bar{a}_{ID})$ . As noted in Section 4.1, there is a range of investments for which ID-arbitration is feasible but E-control is not (See eq. [15]). Furthermore, if there are opportunity costs associated with the entrepreneur's participation, ID-arbitration may even be feasible in circumstances where V-control would fail to provide adequate protection for the entrepreneur's private benefits. The possibility of E opportunity costs is not included in the model above, but it is easy to imagine a scenario in which ID-arbitration could expand the range of firms which receive external financing.

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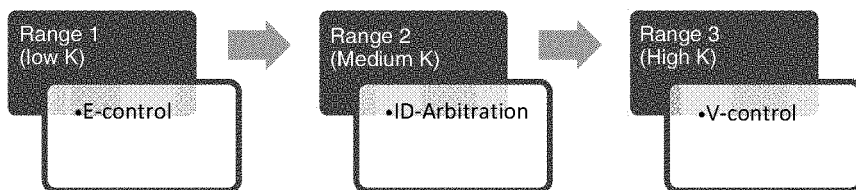
<sup>21</sup> We can compare the renegotiation payments under E-control and ID-arbitration. To reach the first-best under E-control the investor must pay the entrepreneur an amount equal to  $(1 - \pi_E)[y(a^*) - y(\bar{a}_E)]$ ; however, under ID-arbitration the investor only needs to pay  $(1 - \pi_{ID})[y(a^*) - y(\bar{a}_{ID})]$ , where  $\pi_E$  and  $\pi_{ID}$  are the cash-flow rights awarded to E under each governance arrangement respectively. The second renegotiation payment is smaller since  $y(\bar{a}_{ID}) > y(\bar{a}_E)$  and  $\pi_E < \pi_{ID}$ .



We can divide potential investments into three ranges based on the amount invested ( $K$ ) relative to the firm's expected monetary returns under various governance arrangements:

- **Range 1:** use E-control when  $K \leq E(1 - \pi)y(\bar{a}_E)$  for some  $\pi \in [0, 1]$ ;
- **Range 2:** use ID-arbitration when  $E(1 - \pi)y(\bar{a}_E) < K \leq Ey(\bar{a}_{ID})$  for all  $\pi \in [0, 1]$ <sup>22</sup>;
- **Range 3:** use V-control when  $Ey(\bar{a}_{ID}) < K \leq Ey(\bar{a}_V)$ .

The optimal allocation of control rights for each range is illustrated in Figure 2.



**Figure 2:** Optimal board configuration.

The desirable board configuration is driven by two considerations: (i) ex post efficiency and (ii) ex ante feasibility. Ex post efficiency favors E-control (always efficient, *Proposition 1*) and ID-arbitration (efficient unless ID is biased in favor of V, *Proposition 4*) over V-control (potentially inefficient, since renegotiation may be limited by E's wealth, *Proposition 2*).

To be feasible, however, a board configuration must pledge sufficient monetary returns to the investor. E-control is only feasible in Range 1. ID-arbitration is feasible in Ranges 1 and 2, assuming no cost to add an ID to the board, and no uncertainty regarding the ID's preferred outcome.<sup>23</sup> V-control

<sup>22</sup> I am assuming that there is no uncertainty regarding ID's preferred outcome. I am also assuming that there is no cost to adding an independent director. As noted in footnote 16, we could alternatively model ID-arbitration as fixed cost "C" that V would come out of V's initial investment. This refinement would introduce a tradeoff between (i) the cost of adding an independent director to the board, and (ii) the risk of ex post inefficiency under V-control. Range 2 would effectively become "Medium K and Low C", while Range 3 would become "High K and High C", and the comparative statics would be adjusted accordingly. If we introduce cost or uncertainty associated with ID-arbitration, the scope of Range 2 may be somewhat smaller, pushing some firms to use V-control rather than ID-arbitration.

<sup>23</sup> If an ID brings additional cost or uncertainty the scope of Range 2 may be somewhat smaller (see discussion in Section 4.4).

maximizes monetary returns and is feasible in all three Ranges, but may compromise ex post efficiency.

This analysis suggests testable predictions. Firms will move from E-control to ID-arbitration to V-control as the amount invested increases. Also, the size of Range 2 depends on the IDs preferred outcome. Thus, in markets or industry sectors where there are less potential ID candidates, or where IDs are more likely to favor E for whatever reason, we should see less firms using ID-arbitration and more firms using V-control.

## 5 Data on startup boards

These predictions are roughly consistent with empirical evidence from VC contracts. I consider data on board configurations and independent director appointment rights.

Kaplan and Strömberg (2003) classify board control from over 200 rounds of VC financing into four categories: (i) entrepreneur control, (ii) neither VC nor entrepreneur control (i.e., shared control), (iii) VC control in ‘adverse’ state only, and (iv) full VC control. Their “shared” control category is analogous to ID-arbitration, since the tie-breaking vote(s) on these boards are held by independent directors. Kaplan and Strömberg (2003) estimate ordered logit regressions using this board control classification, in the order above, as their dependent variable. The dependent variable increases with the extent of VC control. Kaplan and Strömberg (2003) find positive and significant coefficients for (i) the accumulated amount of VC financing, (ii) pre-revenue ventures, and (iii) firms in industries with a higher volatility, such as R&D-intensive industries. These results suggest that VC’s demand more control as their financing constraint increases, and when there is greater uncertainty regarding the startup’s financial viability. Unfortunately, since these estimates use an ordered (as opposed to an unordered) dependent variable, we cannot separately compare the use of shared control (i.e., ID-arbitration) to E-control or V-control. These results are broadly consistent with my model.

Kaplan and Strömberg interpret the data as supporting Aghion and Bolton’s (1992) model regarding the use of state-contingent control. This characterization makes sense if there are only two actions to choose from. However, if there are more than two possible actions to consider, as in my model, ID-arbitration can behave differently: the independent director may prefer an action that neither the entrepreneur nor the investor would select if given control. My analysis suggests that the use of shared control documented by Kaplan and Strömberg (2003) is not simply an alternate form of state-contingent control, but rather is a distinct decision-making process.

To get a better sense of whether independent directors are expected to perform an arbitrating role, I also consider data on independent director appointments. In VC-backed firms independent directors are mutually appointed by a firm's entrepreneurs and VC investors (Kaplan and Strömberg, 2003). This selection process is addressed in a firm's corporate charter and in voting agreements negotiated in connection with each round of financing. These documents typically specify that independent directors must be "unanimously approved" by the firm's entrepreneurs and VC investors. In other examples, the contract may specify that independent directors must be approved by a majority of the firm's entrepreneurs (common stockholders) and VC investors (preferred stockholders) voting separately (Broughman, 2010). In either case, an independent director must be separately approved by both the entrepreneurs and the investors. This selection process, similar to arbitrator selection generally (Bloom and Cavanagh, 1986), helps ensure that an independent director's interests are not captured by either party. It also suggests that the parties recognize that an independent director may need to settle a disagreement.

## 6 Conclusion

This article addresses an important gap in the financial contracting literature. The literature treats control as "an indivisible right that can be held at any given time by only one party" (Kirilenko, 2001). In contrast, data from VC-backed firms show that board control is typically shared – more than 60% of the time – with a third-party independent director holding the tie-breaking board seat (Kaplan and Strömberg, 2003). Existing financial contracting models cannot explain the most commonly observed startup board configuration.

To fill this gap in the literature, I model the incentives created by a three member board composed of an entrepreneur, an investor, and an independent director ("ID-arbitration"). I use a bargaining game similar to final-offer arbitration to specify a firm's choice of action under ID-arbitration. I show that ID-arbitration can reduce opportunistic behavior by causing the entrepreneur and the investor to converge toward the action most preferred by the independent director. Consequently, ID-arbitration can lead to the efficient outcome in circumstances where alternative governance arrangements – entrepreneur control, investor control, or state-contingent control – are either unavailable or likely to lead to suboptimal results.

My analysis suggests a natural progression of control rights. Firms will shift from entrepreneur control, to ID-arbitration, and finally to investor control as the

financing constraint tightens. These predictions are consistent with empirical evidence from VC contracts, though further empirical testing is needed to rule out alternative explanations that are also consistent with existing data.

This study suggests a need to study more complex control arrangements than what is typically addressed in incomplete contracting models. I expand the literature by considering a particular three-party board structure (ID-arbitration); however, numerous other multi-party control arrangements occur in entrepreneurial finance. Among other concerns, the model in this article could be extended by (i) allowing state-contingent control in conjunction with ID-arbitration, (ii) modeling the use of protective provisions that require unanimous consent for particular actions (i.e., a sale of the firm may require VC consent),<sup>24</sup> and (iii) modeling additional constituencies (i.e., multiple investors with different interests). Similar to the analysis here, models of voting and coalition formation from political science may prove insightful for understanding complex corporate governance arrangements.

## Appendix

**Proposition 3:** *If E and V can observe  $\tau$  and renegotiation is unavailable, then:*

- (i) *In a firm under ID-arbitration E and V both have an incentive to propose the ID's preferred action (i.e.,  $a_E = a_V = \bar{a}_{ID}$ ); and*
- (ii) *Investment under ID-arbitration is feasible if and only if  $K \leq Ey(\bar{a}_{ID})$ .*

**Proof part (i):** Let  $f_E(a_V)$  and  $f_V(a_E)$  be best response correspondences for E and V respectively, given the other party's proposal. I begin with E's best response. If  $a_V \leq \bar{a}_{ID}$  no proposal less than  $a_V$  can defeat  $a_V$ , by definition of  $g$ . So, E's best response is to choose  $a_E = a_V$  or a proposal that would lose to  $a_V$ . This implies that  $f_E(a_V \leq \bar{a}_{ID}) = [a_b, a_V]$ . Alternatively, if  $a_V > \bar{a}_{ID}$  E wants to choose the smallest proposal that defeats  $a_V$ . Such a proposal, however, does not exist, since for any  $a_E < a_V$  where  $g(\tau, a_E) > g(\tau, a_V)$  there exists  $\varepsilon > 0$  such that  $g(\tau, a_E - \varepsilon) > g(\tau, a_E)$ . This follows since  $A$  is a compact action set. Thus,  $f_E(a_V > \bar{a}_{ID}) = \emptyset$ . Still, for any  $a_E$  that beats  $a_V$  it is clear that  $a_V > \bar{a}_{ID}$  is suboptimal for V. Similar arguments show that  $f_V(a_E \geq \bar{a}_{ID}) = [a_E, a_y]$  and  $f_V(a_E < \bar{a}_{ID}) = \emptyset$ , and, similarly, for any  $a_V$  that beats  $a_E$  it is clear that  $a_E < \bar{a}_{ID}$  is suboptimal for E. From above we know that E's best response to  $a_V = \bar{a}_{ID}$  is given by  $f_E(\bar{a}_{ID}) = [a_b, \bar{a}_{ID}]$ , while V's best response to  $a_E = \bar{a}_{ID}$  is given by  $f_V(\bar{a}_{ID}) = [a_b, \bar{a}_{ID}]$ . It follows that  $a_E = a_V = \bar{a}_{ID}$  is a Nash equilibrium because  $\bar{a}_{ID}$  is an element of the best response

<sup>24</sup> Meyersson-Milgrom et al. (2007) addresses the use of targeted shareholder veto rights.

correspondence for both candidates. Now I show uniqueness (i.e.,  $a_E = a_V = \bar{a}_{ID}$  is the only Nash equilibrium). Suppose there is a Nash equilibrium other than  $a_E = a_V = \bar{a}_{ID}$ . Since  $f_E(a_V > \bar{a}_{ID}) = \emptyset$  and  $f_V(a_E < \bar{a}_{ID}) = \emptyset$ , it follows that the only other possible candidates for Nash equilibria must satisfy  $a_V < \bar{a}_{ID} < a_E$ . This relationship in conjunction with  $f_E(a_V < \bar{a}_{ID}) = [a_b, a_V]$  and  $f_V(a_E > \bar{a}_{ID}) = [a_E, a_y]$  implies that  $a_E > a_V$  and  $a_E < a_V$ . This contradiction implies that  $a_E = a_V = \bar{a}_{ID}$  is the unique Nash equilibrium.

**Proof part (ii):** From part (i) we know that  $V$ 's expected utility from ID arbitration is  $EU_V(\bar{a}_{ID}, \pi)$ . When  $\pi = 0$ , it follows that  $U_V = y$  for any choice of action. Thus, if  $K \leq Ey(\bar{a}_{ID})$  there exists  $\pi$  (namely  $\pi = 0$ ) such that investment under ID arbitration satisfies  $V$ 's participation constraint. Conversely, if  $K \leq Ey(\bar{a}_{ID})$  there is no allocation of cash-flow rights under ID-arbitration that would satisfy  $V$ 's participation constraint, since  $\pi \geq 0$ .

**Proposition 5:** *In a firm under ID-arbitration, with  $\bar{a}_{ID}$  distributed uniformly over the action set  $A = [0, 1]$ , and with  $y$  and  $b$  as stated in eqs. [17] and [18] respectively, there is a unique pure strategy Nash equilibrium where  $a_E = 1/4$  and  $a_V = 3/4$ .*

**Proof:** Suppose  $E$  knows that  $V$  will propose some  $a_V \in [0, 1]$ . We can rule out  $a_E > a_V$  since  $E$  would prefer  $a_V$ . Treating  $a_V$  as a fixed parameter,  $E$  will propose  $a_E \in [0, a_V]$  to maximize

$$\max_{a_E} [b(a_E)((a_E + a_V)/2) + b(a_V)(1 - (a_E + a_V)/2)] \quad [A1]$$

Substituting  $b(a) = 1 - a^2$  into eq. [A1] and differentiating with respect to  $a_E$  gives us the following first-order condition:

$$-\frac{3}{2}a_E^2 - a_E a_V + \frac{a_V^2}{2} = 0$$

Solving for  $a_E$  yields two solutions, only one of which is in the range  $[0, a_V]$ . This solution gives us the following best response function:  $a_E(a_V) = a_V/3$ . Since the second derivative of eq. [A1] is negative, this solution is a local maximum for any  $a_V \in [0, 1]$ .

We can solve a similar maximization problem for  $V$  by treating  $a_E \in [0, 1]$  as a fixed parameter and solving  $V$ 's objective function

$$\max_{a_V} [y(a_E)((a_E + a_V)/2) + y(a_V)(1 - (a_E + a_V)/2)] \quad [A2]$$

Differentiating with respect to  $a_V$ , we find the following best response function:  $a_V(a_E) = (2 + a_E)/3$ . Furthermore, the second derivative of eq. [A2] is negative, making this solution a local maximum. To find a Nash equilibrium  $(a_E, a_V)$  we solve the following system of equations, given by each parties' best response function:  $a_E = a_V/3$  and  $a_V = (2 + a_E)/3$ . This gives us the unique solution  $a_E = 1/4$  and  $a_V = 3/4$ .

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